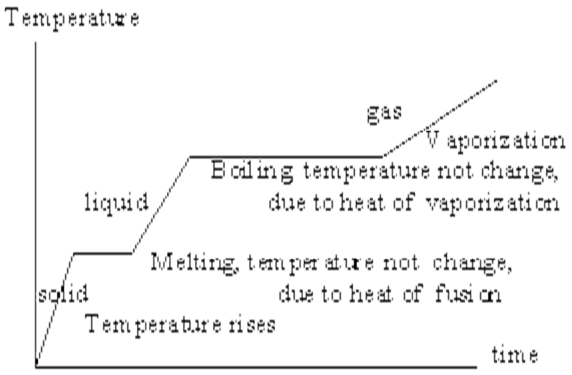
Name _____ AP Chemistry

Heating Curves

When a system is heated, energy is transferred into it. In response to the energy it receives, the system changes, for example, by increasing its temperature. A plot of the temperature versus time is called the *heating curve*, shown below. The physical states of the substance and the phase transitions are identified along the curve.



The temperature of the system usually increases when energy is applied. However, when the energy supplied is used for phase transition, a change in the physical state, the temperature (average kinetic energy) remains constant because the potential energy of the system is being increased as the molecules are rearranged in the phase change.

Example:

The substance, X, has the following properties:

ΔH_{vap} = 20 kJ/mol

ΔH_{fus} = 5.0 kJ/mol

Boiling point = 75°C

Melting point = -15°C

Specific heat:

- Solid = 3.0 J/g°C
- Liquid = 2.5 J/g°C
- Gas = 1.0 J/g°C

Calculate the energy required to convert 250 g of substance X from a solid from -50.0°C to a gas at 100°C. Assume that X has a molar mass of 75.00 g/mol.

Questions:

1) How much energy does it take to convert 0.500 kg of ice at -20°C to steam at 250°C? Specific heat capacities: ice, 2.03 J/g°C; liquid, 4.2 J/g°C; steam, 2.0 J/g°C, ΔH_{vap} = 40.7 kJ/mol, ΔH_{fus} = 6.02 kJ/mol.

2) A 0.250 g chunk of sodium metal is cautiously dropped into a mixture of 50.0 g of water and 50.0 g of ice, both at 0°C. The reaction is

$$2\ Na\ (s) + 2\ H_2O\ (l) \rightarrow 2\ NaOH\ (aq) + H_2\ (g) \qquad \Delta H = -368\ kJ$$

Will the ice melt? Assuming the final mixture has a specific heat capacity of 4.18 J/g°C, calculate the final temperature. The enthalpy of fusion for ice is 6.02 kJ/mol.

3) Determine ΔH_{vap} for magnesium and lithium. In which metal is the bonding stronger?

	Temperature (°C)	
Vapor Pressure (mm Hg)	*Li*	*Mg*
1	750	620
10	890	740
100	1080	900
400	1240	1040
760	1310	1110